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(58) Field of search
B4C

(54) Hand machine tool, particularly hammer drill or percussion drill

(57) In a hand machine tool, particularly a hammer drill, with a drilling transmission (18) and striking mechanism (19) driven by an electric motor, in order to damp the vibrations and to damp the tool recoil impulses, the drilling transmission (18) and the striking mechanism (19) are combined to form a subassembly which is mounted with longitudinal sliding mobility in the interior of the machine housing (10) and is braced against the housing (10) by spring elements and/or damping elements (54,56). The driving connection between the motor shaft (15) and a driving shaft (20) common to the drilling transmission (18) and to the striking mechanism (19) is provided with large axial play (Figure 1).

In another embodiment (Figure 12 not shown) a wobble element (429), which is rigidly connected to a driver (432) of the striking mechanism (419), is arranged on the driving shaft (420) with axial sliding mobility counter to springs (404, 405).

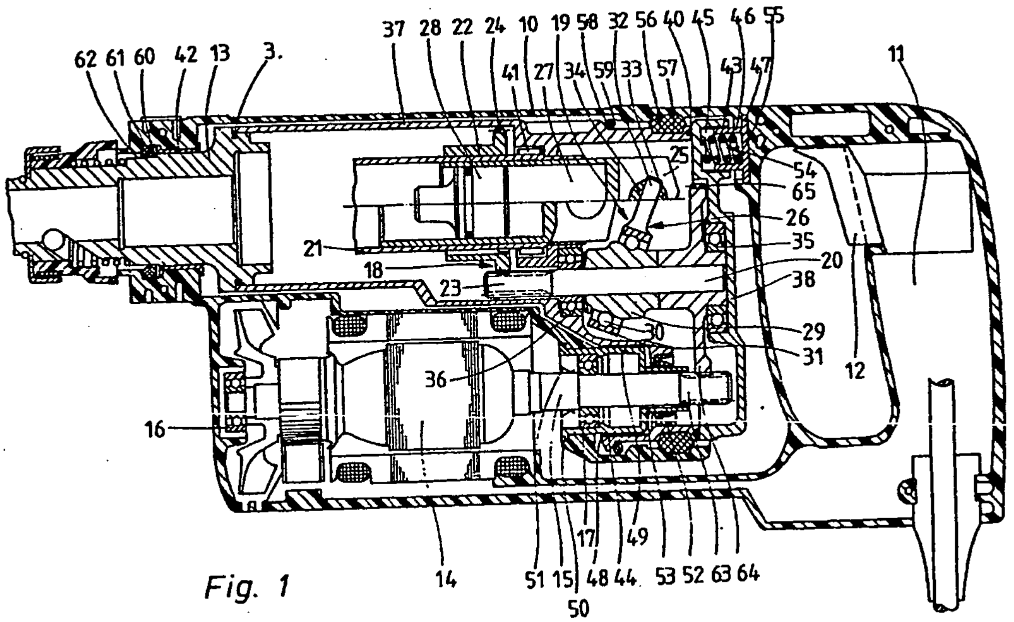

Fig. 1

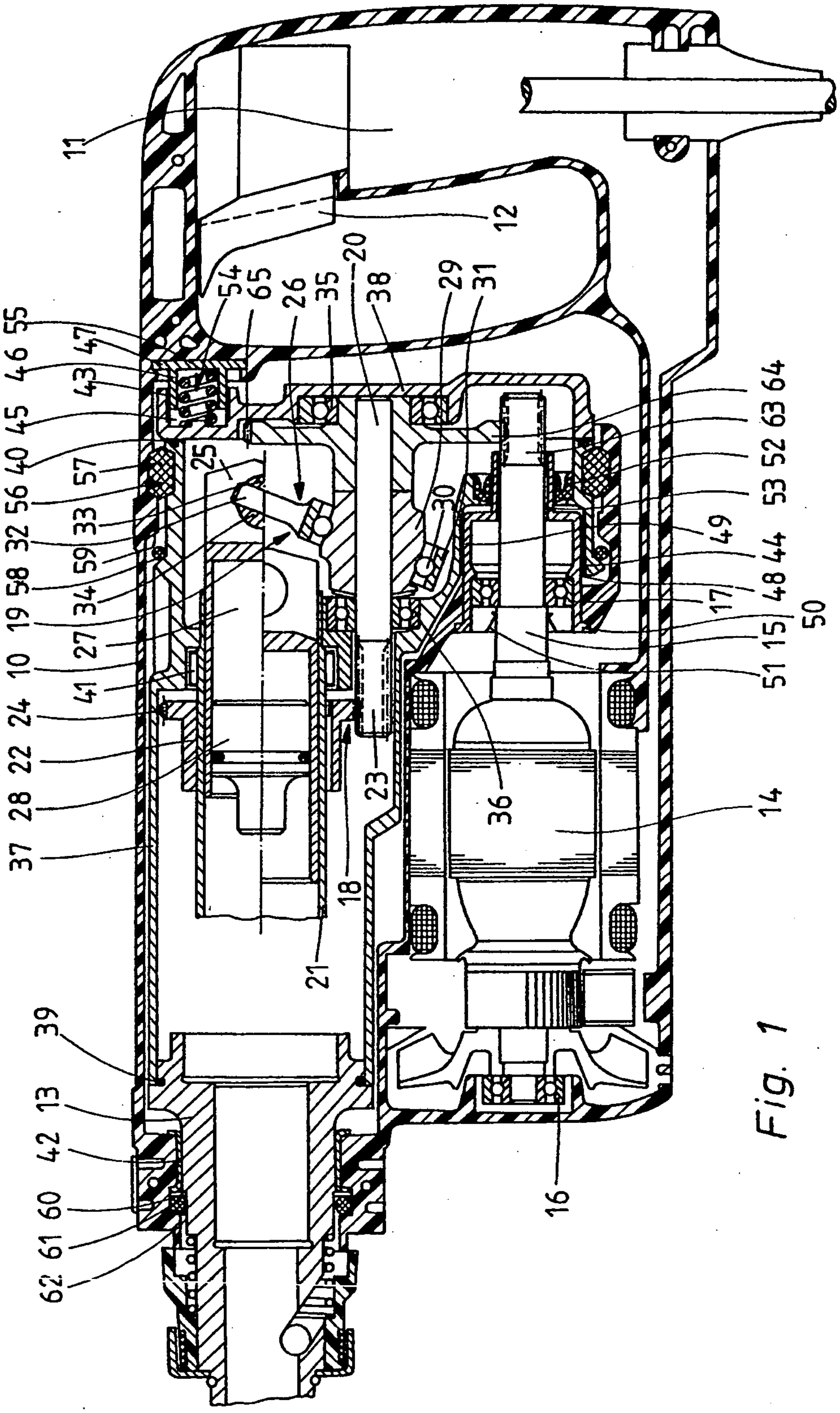

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Fig. 1

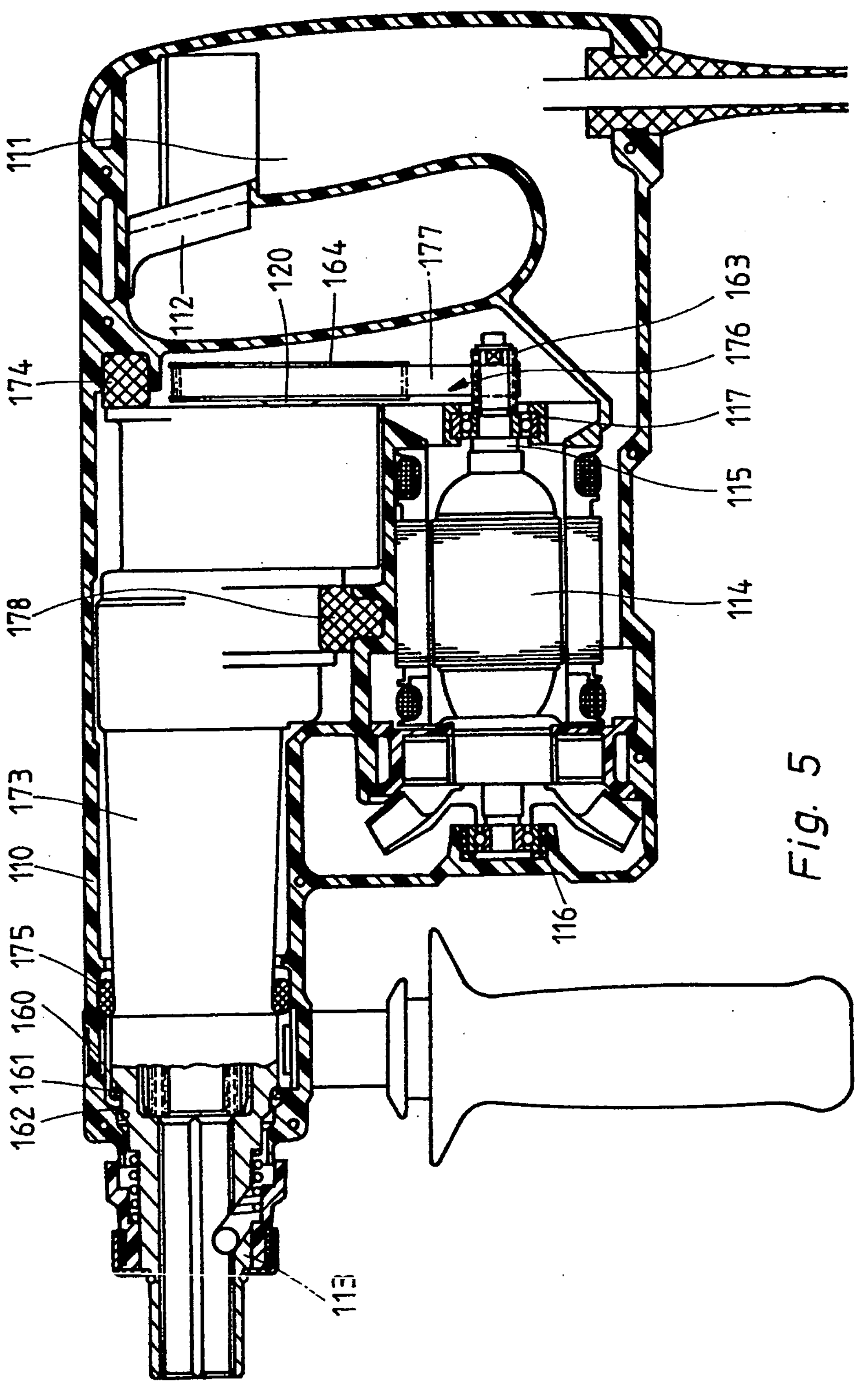
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Fig. 5

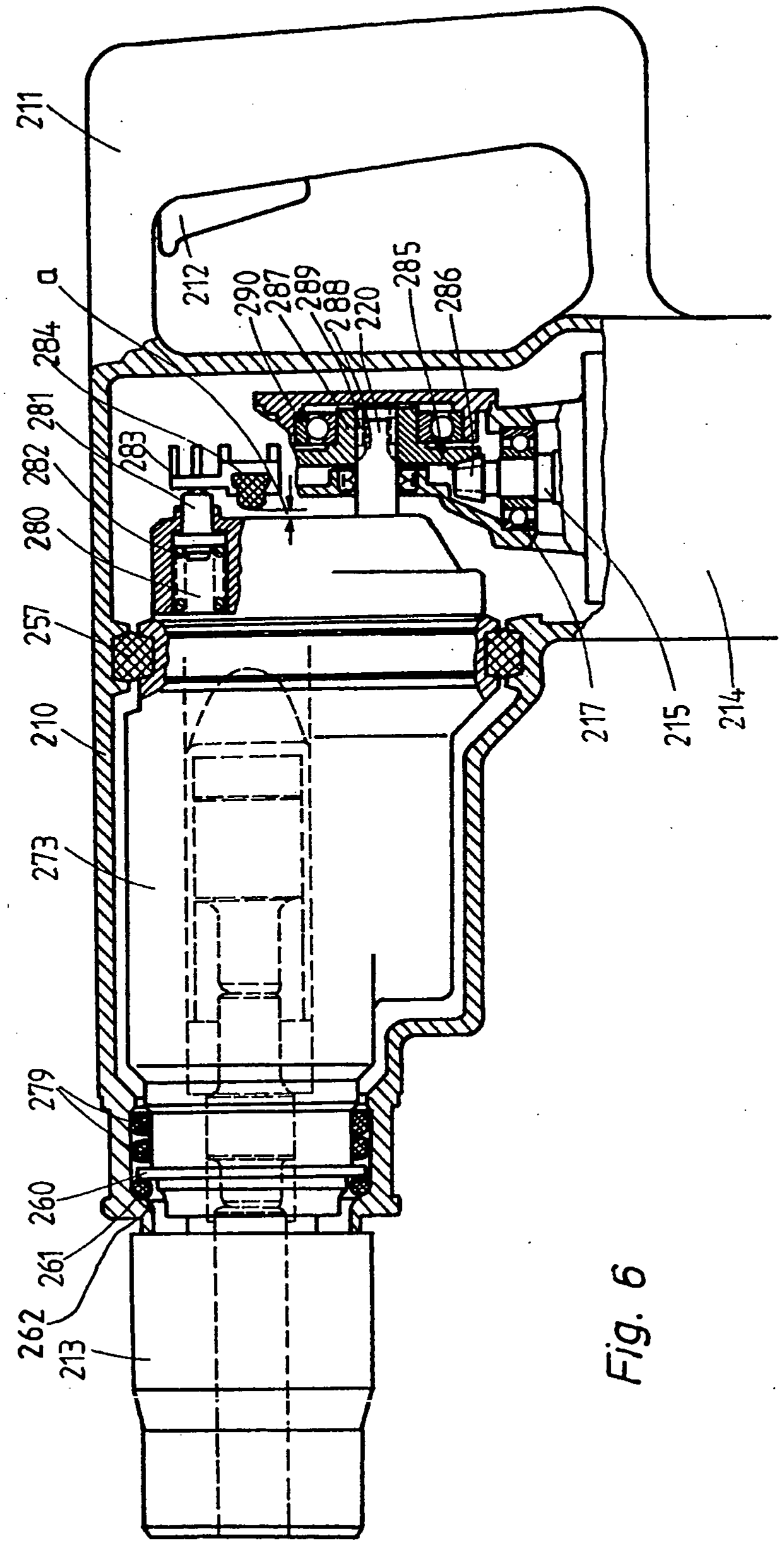
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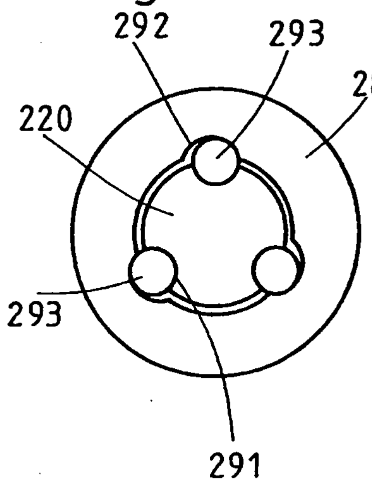
Fig. 6

Fig. 8



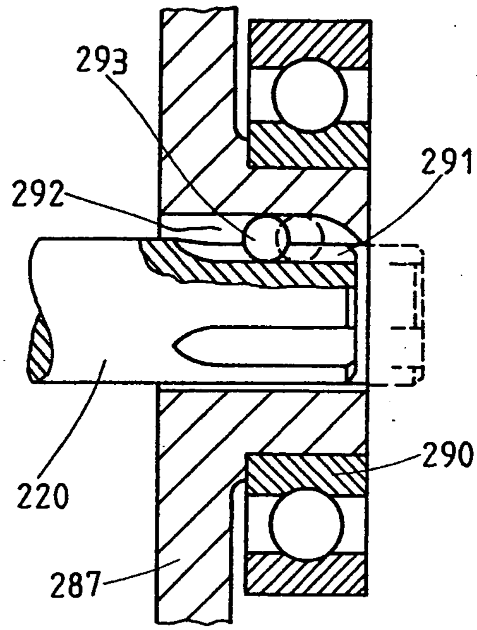


Fig. 7

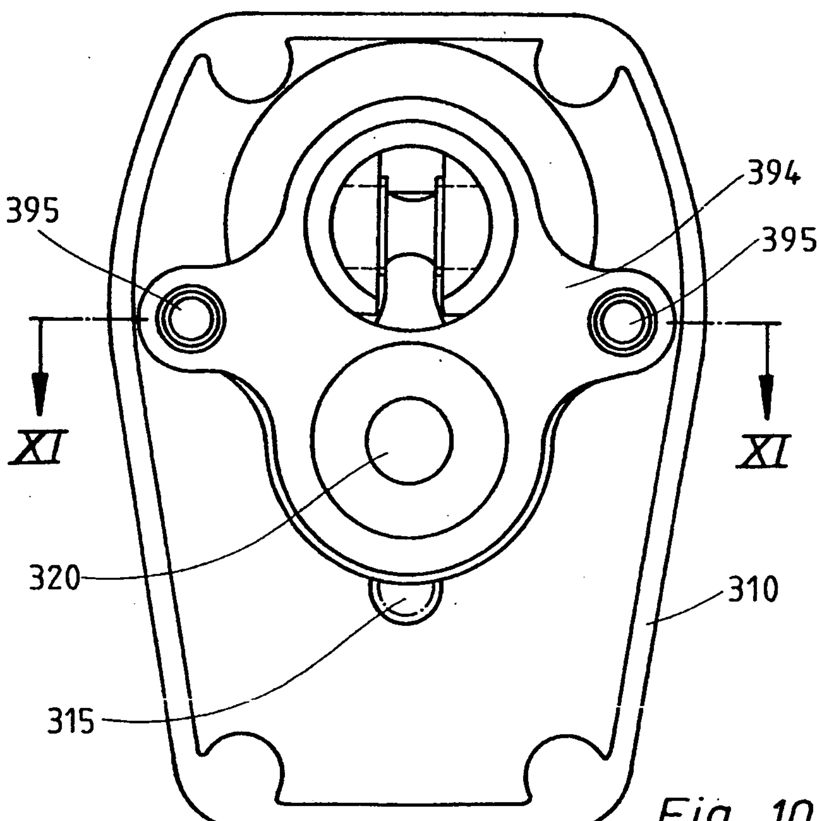


Fig. 10

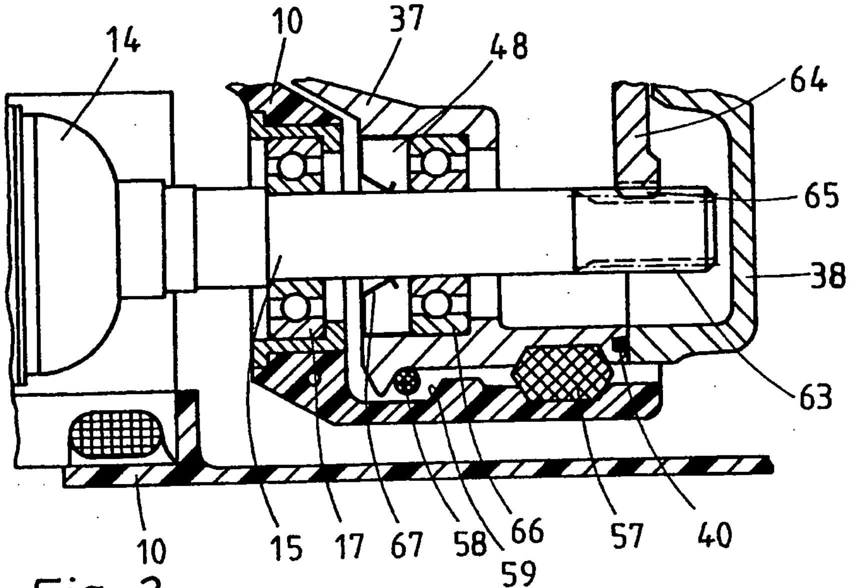


Fig. 2

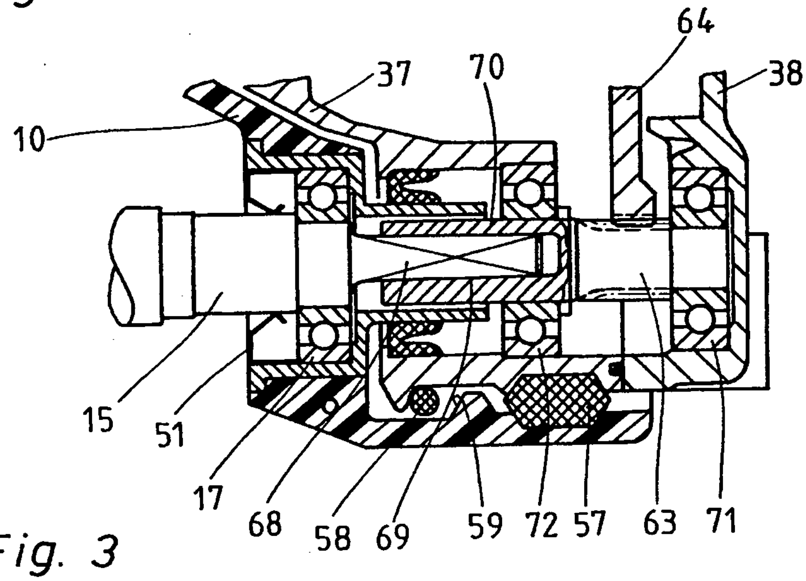


Fig. 3

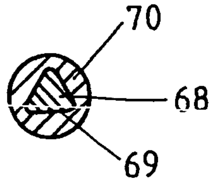


Fig. 4

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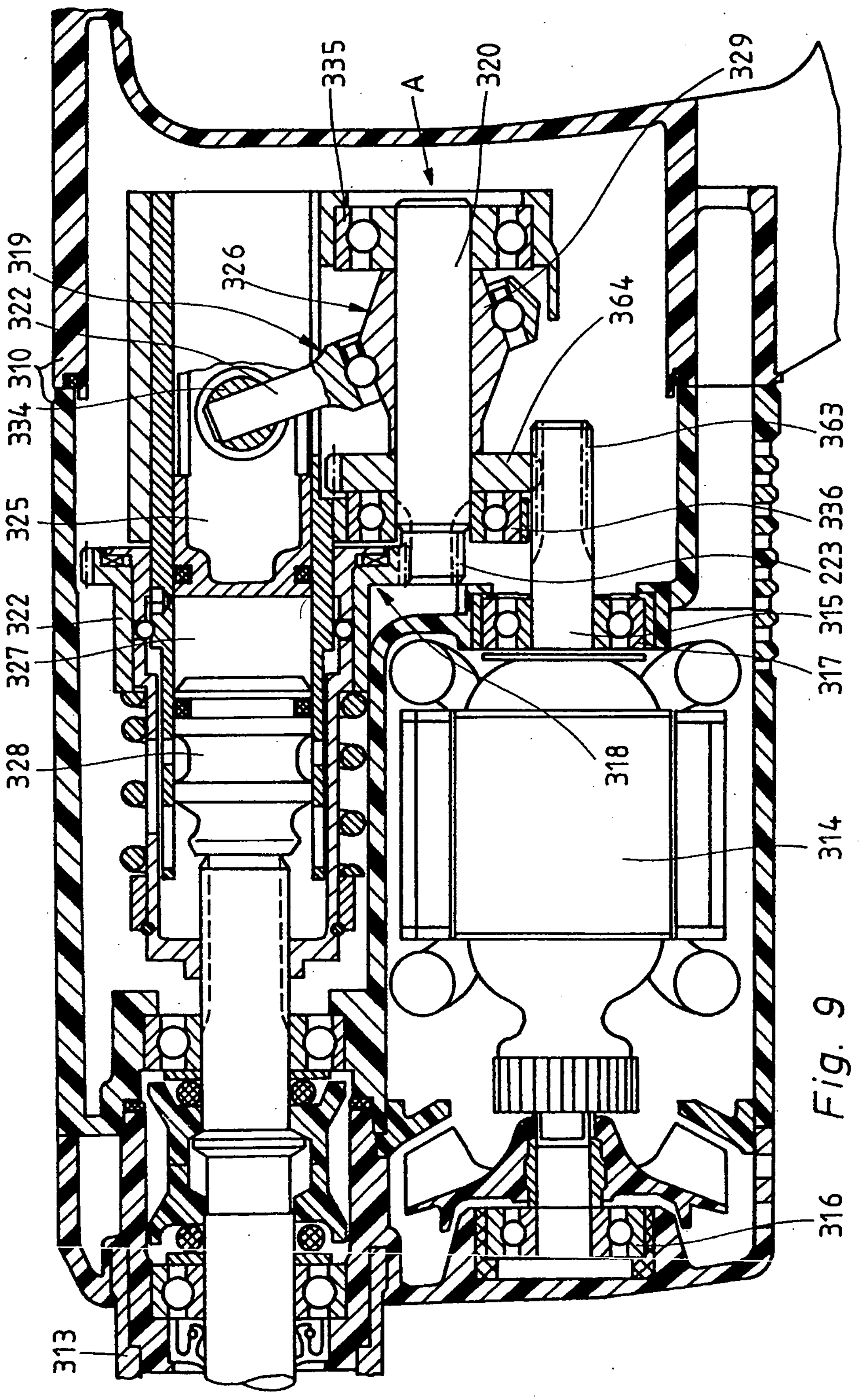

Fig. 9

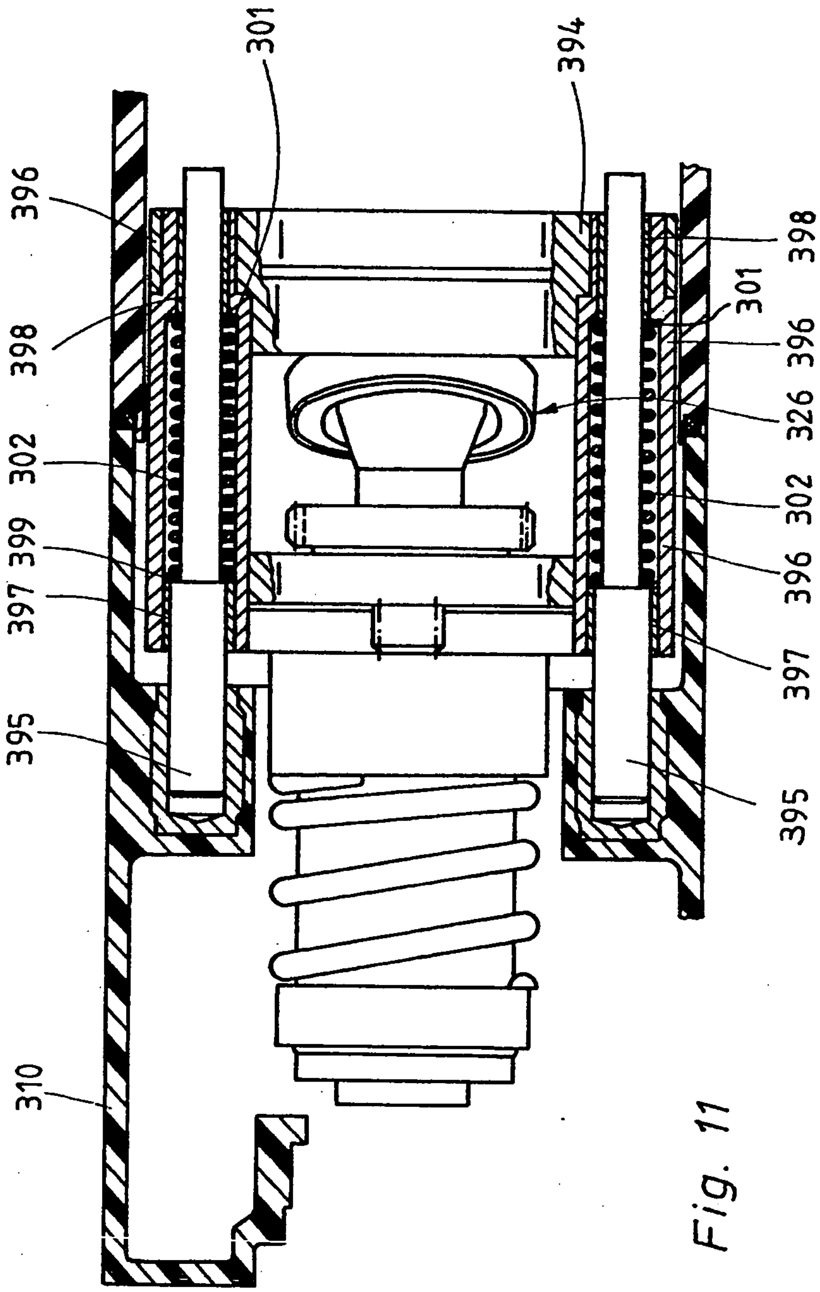
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Fig. 11

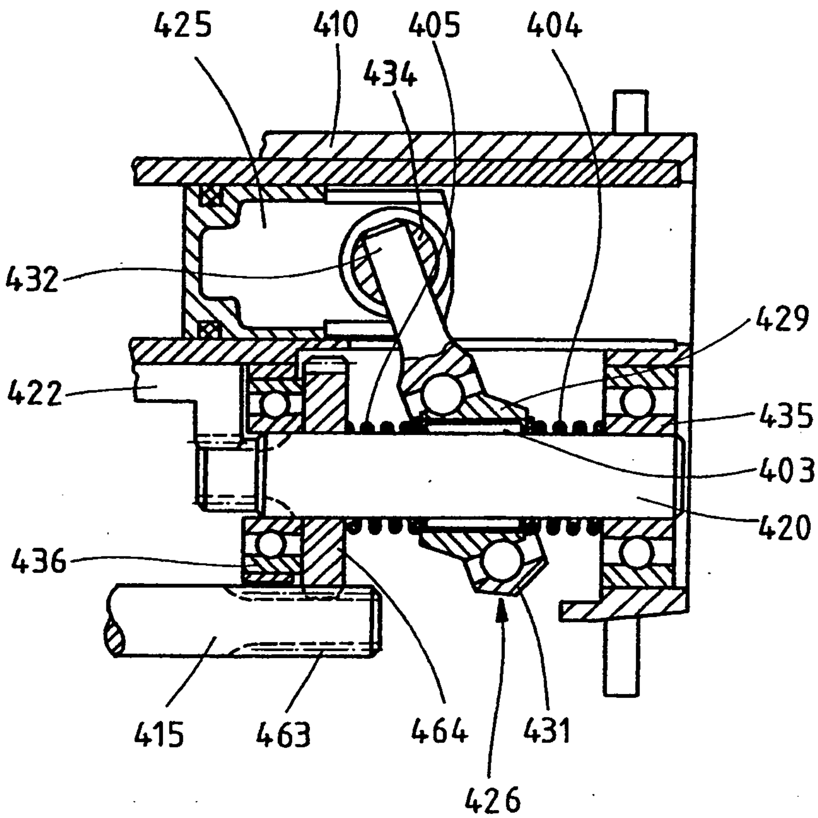
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Fig. 12

SPECIFICATION

Hand machine tool, particularly hammer drill or percussion drill

The invention relates to a hand machine tool, particularly a hammer drill or percussion drill, of the generic type stated in the pre-characterising clause of Claim 1.

Such hand machine tools have to be pressed against the workpiece with appropriate contact pressure by the operator. The vibrations generated by the striking mechanism are transmitted, either totally or only inadequately damped, to the housing, and their full intensity has to be absorbed by the operator.

In a known hammer drill or percussion drill of this type, the handle was sprung relative to the remaining housing accommodating the drilling mechanism and striking mechanism in order to improve the operating comfort. This does lead to a certain, although inadequate, vibration damping to the operator's hand, in so far as the latter uses only the handle in order to hold the hammer drill. However, the damping effect is a function of the contact pressure and of the work direction. Moreover, dictated by the construction, the damping elements have to be arranged in such regions as cannot be lubricated and are exposed to dust.

Advantages of the invention

In comparison with the above, the hand machine tool, particularly hammer drill or percussion drill, according to the invention, with the characterising features of Claim 1, has the advantage that the shocks and vibrations caused by the striking mechanism and by the recoil impulses of the drill (D blows) are transmitted only damped to the housing and to the handle connected firmly thereto. The motor connected rigidly to the housing enlarges the vibrationally decoupled mass of the housing and thus reduces the vibrations which still act on the housing. The proportion of the freely vibrating mass to the residual mass, which determines the damping effect, is substantially more favourable here than in known hammer drills. The contact pressure exerted by the operator upon the hand machine tool no longer passes through the damping and spring elements, so that the latter can be optimised and dimensioned with a view to their actual purpose, which naturally produces substantially better damping characteristics. Furthermore, the vibration damping extends not only to the main handle, but also to an auxiliary handle attached to the housing and overall extends to the entire housing of the hand machine tool. The latter can therefore be guided substantially better with both hands. Also, the manipulation of the hand machine tool is not impaired by the vibration damping. The spring and damping elements can be located in the lubricated regions of the housing, which substantially improves their wearing behaviour. The technical outlay required is small, and the costs low.

Advantageous embodiments of the invention will be apparent from Claims 2—30.

An advantageous embodiment of the invention is also apparent from Claim 31. Due to the vibrational decoupling of the striking mechanism both from the drive means and also from the drilling transmission, according to the invention, the proportion of vibrationally decoupled mass to the residual mass in the case of light-weight housings is further optimised.

Drawing

The invention is explained more fully in the following description with reference to exemplary embodiments illustrated in the drawing, wherein:

Figure 1 shows a longitudinal section of an electric hammer drill,

Figures 2 and *3* each show a detail of the electric hammer drill in Figure 1, modified in the detail region, according to a second and third exemplary embodiment,

Figure 4 shows a cross-section through motor shaft and intermediate shaft overlapping the latter in the electric hammer drill according to Figure 3,

Figure 5 and *6* each show a longitudinal section of an electric hammer drill according to a fourth and fifth exemplary embodiment,

Figure 7 shows an illustration on a larger scale of a driving connection between a bevel wheel and a driving shaft in the electric hammer drill according to Figure 6, in longitudinal section,

Figure 8 shows a cross-section through the bevel wheel and driving shaft in Figure 7,

Figure 9 shows as a detail a longitudinal section of an electric hammer drill according to a fifth exemplary embodiment,

Figure 10 shows a view of the interior of the housing in the direction of the arrow A in Figure 9,

Figure 11 shows a section along the line XI—XI in Figure 10,

Figure 12 shows a detail of a longitudinal section of an electric hammer drill according to a sixth exemplary embodiment.

Description of the exemplary embodiments

The hammer drill illustrated in longitudinal section as an example of a hand machine tool exhibits a housing 10 with handle 11 shaped integrally thereon, on which an electrical on/off switch 12 in the form of a push-button is arranged.

An electric drive motor 14, the motor shaft 15 of which is mounted in two ball bearing 16, 17 fixed to the housing, is connected rigidly to the housing 10 in the interior of the housing. The drive motor 14 is controlled via the on/off switch 12.

The drive motor 14 drives a drilling transmission 18 and a striking mechanism 19, which are likewise arranged in the interior of the housing and convert the rotary movement of the drive motor 14 into a rotary and translatory drive of the tool held in the toolholder 13. Drilling transmission 18 and striking mechanism 19 exhibit for this purpose a common driving shaft 20, which is connected for driving to the motor shaft 15. The construction and function of the drilling transmission 18 and of the striking mechanism 19 are generally known, so that both

are only outlined briefly here:

The tool is set in rotary motion by means of a rotary sleeve 21, upon which is mounted integrally in rotation a driving sleeve 22 with a tooth system 24 engaging into a pinion 23 of the driving shaft 20. A driving piston 25, which is reciprocatingly mobile in the axial direction but restrained from rotation, and is driven in translation by the driving shaft 20 via a wobble transmission 26, slides in the rotary sleeve 21. In Figure 1, the driving piston is shown in its one limit position in the upper half and in its other limit position in the lower half. The driving piston 25 stresses via an air cushion 27 in known manner a striker 28, which surrenders its percussive energy, directly or via an anvil, to the tool. The wobble transmission 26 exhibits a wobble element 29 connected integrally in rotation to the driving shaft 20, and a wobble ring 31 rolling thereon via a ball bearing 30, and having arranged fixed on it a driver 32 aligned radially to the wobble ring 31. The driver engages with play into a transverse bore 33 of a transverse bolt 34, which is arranged within the driving piston 25. The driving shaft 20 is maintained rotatably in two ball bearings 35 and 36.

The drilling transmission 18 and the striking mechanism 19 are combined to form a subassembly, which is mounted in the interior of the housing with longitudinal sliding mobility in the tool axial direction and braced against the housing 10 via spring elements and/or damping elements. In Figure 1 the subassembly is formed by a supporting part 37, to one end face of which the toolholder 13 is attached, and the other end face of which is closed by a protecting cover 38. A seal element 39 and 40 respectively is arranged between the supporting part 37 and each of the toolholder 13 and the protecting cover 38, so that the supporting part 37 with protecting cover 38 and toolholder 13 forms a substantially lubricant-tight housing capsule, into which the tool on the one hand, and the motor shaft 15 of the drive motor 14 on the other hand, project. The ball bearing 35 of the driving shaft 20 is maintained in the protecting cover 38, and the ball bearing 36 in the supporting part 37. The rotary sleeve 21 is braced against the supporting part 37 via a needle bearing 41.

Three sliding bearing bushings 42, 43, 44 are provided as guide means for the subassembly of supporting part 37, tool holder 13 and protecting cover 38 which accommodate the drilling transmission 18 and striking mechanism 19. One sliding bearing bushing 42 is fastened in the spigot-like region of the housing 10 and forms a sliding bearing for the toolholder 13. The second sliding bearing bushing 43 is pressed into a blind bore 45 of the protecting cover 38, which is arranged in a region of the protecting cover 38 approximately axially opposite the toolholder 13. The sliding bearing bushing 43 slides upon a hollow mandrel 46, which is retained positively in the housing 10 via a collar 47. The third sliding bearing bushing 44 is fastened in an annular aperture 48 which surrounds the motor shaft 15 with an interval. The sliding bearing bushing 44 slides upon a prolongation 49 of the bearing bushing 50 of the ball bearing 17 of the motor shaft 15. For a lubricant-tight sealing of the annular aperture, a shaft seal element 51 surrounding the motor shaft 15 is fastened in the bearing bushing 50, and an annular seal element 52, which is retained in the annular aperture 48 of the supporting part 37, rests by its sealing lip upon an annular projection 53 which surrounds the motor shaft 15 with slight play and into which the prolongation 49 of the bearing bushing 50 merges at the free end. The bracing of the subassembly comprising supporting part 37, toolholder 13 and protecting cover 38 in the axial direction, that is to say in the axial direction of the tool, against the housing 10 is effected via a spring element 54 which is formed by a helicoidal compression spring 55 centred in the hollow mandrel 46 and at the bottom of the blind bore 45. The helicoidal compression spring 55 is braced against the bottom of the blind bore and against the bottom of the hollow mandrel.

The bracing of the subassembly comprising supporting part 37, toolholder 13 and protecting cover 38 in the radial direction, that is to say transversely to the tool axis, against the housing 10, is effected via a damping element 56 which is constructed in this case as a rubber profile 57, which abuts as a ring between the supporting part 37 and the interior wall of the housing 10. By this rubber profile 57, on the one hand vibrations of the plastic housing 10 are damped, and on the other hand a progressive spring characteristic is obtained in cooperation with the helicoidal compression spring 55 to damp both the vibrations generated by the striking mechanism 19 and the recoil impulses caused by the drill. When the helicoidal compression spring 55 and the rubber profile 57 are stressed in the sliding direction of the subassembly beyond an admissible degree, the supporting part 37 braces itself via an O-ring 58 against an annular shoulder 59 projecting from the interior wall of the housing 10. At standstill, under no load or when the tool is removed from the toolholder 13, the subassembly in braced via an annular disc 60 attached to the toolholder 13, and an O-ring 61, against a further annular shoulder 62 of the housing.

The driving connection between the motor shaft 15 and the driving shaft 20 common to the drilling transmission 18 and to the striking mechanism 19 is formed here by a pinion 63 mounted on the motor shaft 15 and by a gear 64 which meshes with the pinion 63 and is mounted integrally in rotation on the driving shaft 20. The length of the pinion 23 is made substantially greater than the length of the tooth system 65 of the gear 64 which meshes with the pinion 63, so that an axial sliding can occur between gear 64 and pinion 63 without the rotary connection being cancelled. The nature of the force transmission and the characteristic of the springing and damping can be influenced permanently through the configuration of the tooth system of pinion 63 and gear 64.

In a modification, not shown, of the described electric hammer drill, the thrust bearing formed by

the third sliding bearing bushing 44 and the prolongation 49 of the bearing bushing 50 of the ball bearing 17 may be omitted and, instead, a further thrust bearing of identical construction to that formed by the sliding bearing bushing 43 and the hollow mandrel 46 be provided between protecting cover 38 and housing 10. This thrust bearing should conveniently be arranged in that region of the protecting cover 38 which is approximately aligned with the motor shaft 15.

Figure 2 shows a further modification of the electric hammer drill illustrated in Figure 1. Here again the sliding bearing formed by the third sliding bearing bushing 44 and by the prolongation 49 of the bearing bushing 50 of the ball bearing 17 is omitted. The annular aperture 48 surrounding the motor shaft 15 at a radial interval is braced here via a pivot bearing 66 against the motor shaft 15. The pivot bearing 66 is maintained in the annular aperture 48 and admits an axial sliding of the inner bearing sleeve upon the motor shaft 15. Lubricant sealing is effected here by a single shaft seal element 67, which is fastened in the annular aperture 48. In the case of this cheapest mode of sealing it is necessary to ensure that no dust can enter the sealing means, which is achieved by the O-ring 61 and the rubber profile 57.

Figures 3 and 4 show a further modification of the electric hammer drill illustrated in Figure 1. Compared to Figure 1, only the driving connection between motor shaft 15 and driving shaft 20 of drilling transmission 18 and striking mechanism 19 is modified here. Here the motor shaft 15 supports at its free end a splined shaft profile 68, which engages positively and with axial sliding mobility into a corresponding hollow profile 69 of an intermediate shaft 70 aligned with the motor shaft 15. The intermediate shaft 70 is mounted rotatably in two ball bearings 71, 72, of which the ball bearing 71 is retained in the protecting cover 38 and the ball bearing 72 in the supporting part 37. The intermediate shaft 70 carries the pinion 63, with which the gear 64 mounted on the driving shaft 20 meshes as described. The splined shaft profile 68 and the hollow profile 69 are each constructed as a trihedral profile in this case. The intermediate shaft 70 is fixed in the axial direction. The required axial sliding in the transmission connection is ensured by the splined shaft profile 68 and the hollow profile 69.

A further exemplary embodiment of an electric hammer drill may be seen in longitudinal section in Figure 5. Those components identical with figure 1 are designated by the same reference numerals, which have been increased by 100 for differentiation. Here again, the drilling transmission and striking mechanism, not shown in detail, are combined to form a common subassembly, which in this case is arranged in a closed housing capsule 173. The housing capsule 173 is again guided with axial sliding mobility in the housing 110 and braced against the housing 110 in the longitudinal direction, that is to say in the tool axial direction, via a spring element 174, which is constructed as a rubber buffer in this case. The bracing in the radial direction is effected by a damping ring 175, which surrounds the housing capsule 173 in its front region facing the toolholder. The bracing of the housing capsule 173 at standstill, under no load or when the tool is removed, is again effected by an O-ring 161, which is braced against an annular shoulder 162 in the housing 110. The transmission connection between the motor shaft 115 of the drive motor 114, which is again connected firmly to the housing 110, with the driving shaft 120 common to the drilling transmission and striking mechanism, is formed in this case by a belt transmission 176. A toothed belt 177 meshes on the one hand with the pinion 163 of the driving shaft 115, and on the other hand with the gear 164 mounted integrally in rotation on the driving shaft 120. A tensioning spring, constructed in this case as a rubber block 178, is provided to tension the toothed belt 177. The rubber block 178 is braced on the one hand against the drive motor 114 and on the other hand against the housing capsule 173. Otherwise the construction and function of the electric hammer drill in Figure 5 are identical to the electric hammer drill in Figure 1.

A further exemplary embodiment of an electric hammer drill is illustrated in longitudinal section in Figure 6. Components identical to Figure 1 are designated by the same reference numerals, but increased by 200. In this electric hammer drill the motor shaft 215 of the drive motor 214 is arranged at right angles to the tool axis and to the common driving shaft 220 of the drilling transmission and striking mechanism, not shown in detail. Drilling transmission and striking mechanism are again combined to form a subassembly and accommodated in a lubricant-tight housing capsule 273. The latter is again guided in the axial direction in the housing 210 and braced against the housing 210 in the axial direction and radial direction via spring elements and damping elements. In this case, similarly to in Figure 5, one or more O-rings 279 serve for the resilient mounting, which also simultaneously permits the axial sliding, and are arranged in the front region, facing the toolholder 213, of the housing capsule 273 between the latter and the interior wall of the housing 210. In the rear region the housing capsule 273 is braced relative to the housing 210 by a rubber profile 275, which is stressable in shear. In the end face, remote from the toolholder 213, of the housing capsule 273, there is provided a stepped bore 280, in which a bolt 281 is guided which projects above the end face of the housing capsule 273 under the action of a compression spring 282 occupying the stepped bore 280 and is pressed against a housing web 283. Compression spring 282, bolt 281 and housing web 283 produce the bracing of the housing capsule 273 against the housing 210 in the axial direction, that is to say in the direction of the tool axis. During the axial sliding of the housing capsule 273, the O-rings 279 roll and the rubber profile 257 is stressed in shear. In order to limit the axial stroke of the housing capsule 273, a rubber buffer 284 located opposite the end face of the housing capsule 273 at a prescribed interval a is arranged fixed in

the housing 210. At standstill, under no load or when the tool is removed from the toolholder 213, the housing capsule 273 is again braced via an annular disc 260 against the housing capsule 273, and via an O-ring 261 against an annular shoulder 262 of the housing 210.

The operative connection between motor shaft 215 and driving shaft 220 is formed on the one hand by a mitre transmission 285 with a bevel gear 286 mounted on the motor shaft 215 and with a bevel wheel 287 meshing therewith and fixed to the housing, and on the other hand by a splined shaft profile 288 on the driving shaft 220, which engages with a corresponding hollow profile 289 in the bevel wheel 287. During axial sliding of the driving shaft 220 in the bevel wheel mounted via a ball bearing 290 fixed to the housing, the splined shaft profile 288 and the hollow profile 289 can slide in each other without the rotational connection being lost.

When large torques are transmitted in the region of the splined shaft profile 288 and hollow profile 289, powerful normal forces occur at their flanks, which result in corresponding friction forces. In some circumstances, this may cause an inadmissibly high proportion of the vibrations of the housing capsule 273 to be transmitted to the mitre transmission 285 and hence to the housing 210 of the electric hammer drill. This is remedied by a modification in the connection between the driving shaft 220 and the bevel wheel 287, which is illustrated in Figures 7 and 8. Here the driving shaft 220 and bevel wheel 287 each exhibit three axial grooves 291 and 292 respectively staggered uniformly at 120° on the circumference, which are mutually opposite. each two opposite axial grooves 291 and 292 contain a steel ball 293, whereby the bevel wheel 287 and the driving shaft 220 are positively mutually connected in the direction of rotation. The diameter of the steel balls 293 is dimensioned approximately equal to the width and half the depth of the axial grooves 291, 292. During axial sliding of the driving shaft 220 in the bevel wheel 287, the balls 293 roll along the groove bottom. The axial groove 291 and 292 are closed at one end face. The respective closed ends of the axial grooves 291 on the driving shaft 220 are associated with the open ends of the groove 292 in the bevel wheel 287. The length of the grooves is chosen so that, in the operating condition, the egress of the balls to both sides is blocked by the respective groove end inthe driving shaft 220 or in the hub of the bevel wheel 287. The projection of the axial grooves 291, 292 is shaped so that it is impossible for the steel balls 293 to become jammed. Errors of alignment can be compensated to a limited degree by using one ball per axial groove. In the case of extremely small alignment errors, a plurality of balls 293 may be used for each axial groove 291 and 292 to transmit large torques.

Figures 9—11 illustrate a further exemplary embodiment of an electric hammer drill, which corresponds in its essential construction and function to the electric hammer drill described with reference to Figure 1. Identical components are therefore designated by the same reference numerals, which have been increased by 300. Once again, the drilling transmission 318 and striking mechanism 319 are combined to form a subassembly which is mounted with axial sliding mobility in the housing 310 and is braced against the housing 310 via spring elements and damping elements. The operative connection between the motor shaft 315 of the drive motor 314, which is again connected rigidly to the housing, and the driving shaft 320 common to the striking mechanism 319 and to the drilling transmission 318, is again formed by a pinion 363 on the motor shaft 315 and by a gear 364 mounted integrally in rotation on the driving shaft 320. The housing 310 is constructed with two shells in this case.

The drilling transmission 318 and striking mechanism 319 in this case are arranged in common on a bearing block 394 (Figures 10 and 11), which is fastened to the housing 310 via a sliding bearing admitting an axial sliding of the bearing block 394. The sliding bearing is formed here by two stay bolts 395 retained in the housing 310 and two guide tubes 396 connected firmly to the bearing block 394, which slide on the stay bolts 395 by two guide sleeves 397, 398 pressed in at a mutual interval. The stay bolts 395 are arranged opposite in one plane in the housing 310 and are relatively long. The stay bolts exhibit, near one guide sleeve 397, an annular shoulder formed by an annular disc 399, whereas the guide tubes 396 likewise carry, near the other guide sleeve 398, an annular shoulder formed by an annular disc 301. In each case, a helicoidal compression spring 302 coaxially surrounding the stay bolt 395 is braced between the two annular discs 399 and 301. The helicoidal compression springs 302 acting in both sides of the sliding direction of the bearing block 394 form the spring and damping elements, via which the subassembly comprising drilling transmission 318 and striking mechanism 319 is braced against the housing 310 in the axial dirction, that is to say in the direction of the tool axis. The construction and function of the drilling transmission 318 and striking mechanism 319 are the same in principle as that described with reference to Figure 1. The wobble transmission 326 and driving piston 325 are therefore designated by the same reference numerals increased by 300.

Another variant of the electric hammer drill described above is illustrated in Figure 12. Figure 12 shows a detail of a longitudinal section of an electric hammer drill. The construction of the drilling transmission 418 and of the striking mechanism 319 corresponds to that in Figures 9—11. The drilling transmission 418 and striking mechanism 319 again exhibit a common driving shaft 420 which is mounted in ball bearings 435 and 436 in the housing 410. The driving shaft 420 is again driven by the motor shaft 415 of the drive motor, not shown, via a pinion 463 and gear 464. The rotating driving shaft 420 again meshes with a drive sleeve 422 of the drilling transmission 418 and, via a wobble transmission 426, drives a driving piston 425 of the striking mechanism 419, for which purpose the

driver 432 connected to the wobble ring 431 again engages in a pivot bolt 434 which is mounted with pivotal mobility in the driving piston 425. Contrary to Figure 9, the wobble element 429 is not connected rigidly to the driving shaft 420, but is merely coupled to the driving shaft 420 integrally in rotation but slidably in the axial direction. The coupling is ensured by a pinion tooth system 403 but may likewise be effected by a spline, for example. An end face of a helicoidal compression spring 404 or 405, the other end face of which abuts the ball bearing 435 or the gear 464, is braced against each of the two sides of the wobble element 429. This further development decouples the striking mechanism 419 vibrationally from the drilling transmission 418, from the drive motor and from the remainder of the housing 410, for the same purpose of damping the vibration caused by the striking mechanism 419 and damping the recoil impulses generated by the tool. The axial sliding mobility of the wobble element 429, and its spring bracing, via the ball bearings 435, 436, against the housing 410, to which the drive motor and drilling transmission 418 are firmly connected, permit the vibrations to be considerably isolated and damped fom the housing 410, and therefore from the handle and auxiliary handle.

The invention is not limited to the exemplary embodiments described. Thus, instead of the splined shaft profile/hollow profile connection between the motor shaft 15 and intermediate shaft 70 in Figures 3 and 4, an identical groove and ball connection to that illustrated in Figures 7 and 8 may be provided.

CLAIMS

1. Hand machine tool, particularly a hammer drill or percussion drill, with a housing, with a toolholder, with a drilling transmission and striking mechanism arranged in the interior of the housing for the drive in rotation and in translation of a tool held in the toolholder, and with a drive motor fastened to the housing in the interior of the housing, the motor shaft of which is connected for driving to the drilling transmission and to the striking mechanism, characterised in that the striking mechanism (19; 319) and at least part of the components belonging to the transmission train between drive motor (14) and striking mechanism (19;319) are combined to form a subassembly which is mounted with longitudinal sliding mobility in the tool axis direction in the interior of the housing and is braced against the housing (10;110;210;310) via spring elements and/ damping elements.

2. Machine according to Claim 1, characterised in that the striking mechanism (19) and the parts forming a subassembly conjointly therewith are arranged in a closed housng capsule (13;37;38;173;273) which is braced against the housing (10;110;210) in the axial direction via spring elements (54;174;282).

3. Machine according to Claim 2, characterised in that the housing capsule (13,37,38;173;273) is braced against the housing (10;110;210) in the radial direction via damping elements (56;175;275;279), preferably rubber rings.

4. Machine according to Claim 2 or 3, characterised in that sliding bearings are provided between the housing (10;110;210) and housing capsule (13,37,38;173;273).

5. Machine according to Claim 2 or 3, characterised in that the housing capsule (273) is centred in the housing (210) in the front region facing the tool by means of at least one O-ring (279) and in the rear region remote therefrom by means of a profile ring (257) stressable in shear, and that at least one compression spring (282) extending in the axial direction, which presses a bolt (281) projecting beyond the end face against a housing web (283), is arranged in that end face of the housing capsule (273) remote from the tool.

6. Machine according to Claim 2 or 3, characterised in that the housing capsule (273) is formed by the toolholder (13), by a protecting cover (38) and by a supporting part (37) connected impermeably to the toolholder (13) and protecting cover (38).

7. Machine according to Claim 6, characterised in that the toolholder (13) is guided with axial sliding mobility in a sliding bearing bushing (42) fixed to the housing, and that at least one further sliding bearing bushing (43) aligned in the axial direction of the toolholder (13) and sliding on a hollow mandrel (46) fixed to the housing is retained in the protecting cover (38).

8. Machine according to Claim 7, characterised in that the further sliding bearing bushing (43) is pressed into a depression or blind bore (45) of the protecting cover (38), which is preferably arranged in a region of the protecting cover (38) opposite the toolholder (13), and that the hollow mandrel (46) is retained positively in the housing (10) by means of a collar (47).

9. Machine according to Claim 7 or 8, characterised in that the spring element is constructed as a compression spring occupying the hollow mandrel (46), which is braced against the protecting cover (38) on the one hand and against the bottom of the hollow mandrel (46) on the other hand.

10. Machine according to any of Claims 6—9, characterised in that the motor shaft (15) is mounted in at least one pivot bearing (17) that occupies a bearing bushing (50) retained in the housing (10), that the bearing bushing (50) exhibits a prolongation (49) projecting axially beyond the pivot bearing (17), and that the supporting part (37) exhibits an annular aperture (48) which engages round the prolongation (49) and a third sliding bearing bushing (44) sliding on the prolongation (49) is fastened.

11. Machine according to Claim 10, characterised in that a shaft seal element (51) surrounding the motor shaft (15) is fastened in the bearing bushing (50), that the prolongation (49) of the bearing bushing (50) merges into a cylindrical annular projection (53) surrounding the motor shaft (15), and that an annular seal element (52), the sealing lip of which rests upon the annular projec-

tion (53), is retained on the annular aperture (48) of the supporting part (37).

12. Machine according to any of Claims 6—9, characterised in that the supporting part (37) is braced against the driving shaft (15) by means of a pivot bearing (66) (Figure 2).

13. Machine according to Claim 12, characterised in that the suppoting part (37) exhibits an annular aperture (48) surrounding the motor shaft (15) with a radial interval, that the pivot bearing (66) constructed as a ball bearing is fastened by one bearing race in the annular aperture (48) and is mounted slidingly by the other bearing race on the motor shaft (15), and that a shaft sealing element (67) tightly surrounding the motor shaft (15) is retained at the annular aperture (48) (Figure 2).

14. Machine according to any of Claims 1—13, characterised in that the subassembly consisting of the striking mechanism (19;319) and at least a part of the components belonging to the transmission train between the drive motor (14) and striking mechanism (19;319) also comprises the drilling transmission (18;318).

15. Machine according to any of Claims 1—14, characterised in that in the transmission connected to the motor shaft (15), at least one of the transmission elements is axially slidable relative to one or more of its adjacent elements operatively associated with it.

16. Machine according to any of Claims 1—15, characterised in that the driving connection between the motor shaft (15) and the driving shaft (20) of drilling transmission (18) and striking mechanism (19) is formed on the one hand by a pinion (63) on the motor shaft (15) and on the other hand by a gear (64) mounted on the driving shaft (20), and that the pinion length is dimensioned substantially greater than the axial tooth system (65) of the gear (64) which meshes with the pinion (63).

17. Machine according to any of Claims 1—15, characterised in that the driving connection between the motor shaft (15) and the driving shaft (20) is formed by a splined shaft, polygonal or other profile (68) on the motor shaft (15), by a hollow profile (69), positive with the profile (68), on an intermediate shaft (70), which is engaged with axial sliding mobility by the profile (68), is formed by a pinion (63) on the intermediate shaft (70) and by a gear (64), meshing with the latter, on the driving shaft (20) (Figures 3 and 4).

18. Machine according to any of Claims 1—15, characterised in that the driving connection between the motor shaft (115) and the driving shaft (120) is formed by a belt transmission (176), preferably a V-belt or toothed belt transmission.

19. Machine according to Claim 18, characterised in that a tensioning spring, preferably a rubber spring (178), which tensions the belt (177) of the belt transmission (176), is braced against the housing capsule (173) on the one hand and against the drive motor (114) on the other hand.

20. Machine according to any of Claims 1—15, characterised in that the driving connection between the motor shaft (214) and driving shaft (220) is formed by a mitre transmission (285) which consists of a bevel gear (286) mounted on the motor shaft (215) and of a bevel wheel (287) fixed to the housing and meshing therewith, and by a splined shaft profile (288) arranged on the driving shaft (220), which engages positively and with axial sliding mobility in a corresponding hollow profile (289) in the bevel wheel (287).

21. Machine according to Claim 17 or 20, characterised in that instead of the mutually sliding, hollow and splined shaft profile (69,68;289,288) of the intermediate shaft (70) and motor shaft (15) or bevel wheel (287) and driving shaft (220), the motor shaft (15) and intermediate shaft (70) or driving shaft (220) and bevel wheel (287) exhibit axial grooves (291,292) distributed on the circumference in their opposite wall regions, and that balls (293) of a diameter corresponding approximately to the width of the axial groove (291,292) occupy opposite axial grooves (291,292) of motor shaft (15) and intermediate shaft (70) or driving shaft (220) and bevel wheel (287) (Figures 7 and 8).

22. Machine according to Claim 21, characterised in that the respectively opposite axial grooves (291,292) of the motor shaft (19) and intermediate shaft (70) of driving shaft (220) and bevel wheel (287) are closed at the respective opposite end and that the length of the axial grooves (291,292) and the number of the balls (293) occupying two mutually opposite axial grooves (291,292) are dimensioned in accordance with the maximum required axial sliding between motor shaft (15) and intermediate shaft (20) and driving shaft (220) and bevel wheel (287) (Figures 7 and 8).

23. Machine according to any of Claims 2—22, characterised in that the housing capsule (13,37,38;173;273) carries in the front region facing the tool an annular shoulder (60;160;260) by which it is braced in the axial direction of the tool by an O-ring (61;161;261) against a shoulder (62;162;262) fixed to the housing at standstill, under no load, or when the tool is removed from the toolholder (13;113;213).

24. Machine according to Claim 23, characterised in that the annular shoulder is formed by an annular disc (60) conenected to the toolholder (13).

25. Machine according to any of Claims 2—24, characterised in that a damping stop (58;175;284) is provided between the housing (10;110;210) and housing capsule (13,37,38;173;273) in order to limit the axial sliding of the housing capsule (13,37,38;173;273).

26. Machine according to Claim 14, characterised in that the drilling transmission (318) and the striking mechanism (319) are maintained in a bearing block (394), that at least one sliding bearing is provided between the bearing block (394) and housing (310), and that spring elements (302) acting in both sliding directions of the bearing block (394) are arranged between the bearing block (394) and the housing (310).

27. Machine according to Claim 26, characterised in that the sliding bearing is formed by two stay bolts (395) preferably mutually opposite in one plane, and by guide sleeves (397,398) slidable thereon.

28. Machine according to Claim 27, characterised in that the stay bolts (395) are firmly connected to the housing (310), and the guide sleeves (397,398) to the bearing block (394).

29. Machine according to Claim 27 or 28, characterised in that the stay bolts (395) are of long construction and two guide sleeves (397,398) maintained at a mutual interval are mounted on each stay bolt (395).

30. Machine according to Claim 29, characterised in that the two guide sleeves (397,398) are pressed into a guide tube (396) connected to the bearing block (394), that the stay bolts (395) near one guide sleeve (397) and the guide tube (396) near the other guide sleeve (398) respectively exhibit an annular shoulder (399, 301), and that a compression spring (302) preferably a helicoidal compression spring coaxially surrounding the stay bolt (395), is braced between the two annular shoulders (399,301).

31. Machine according to the pre-characterising clause of Claim 1, wherein the striking mechanism exhibits a driving piston guided in a striking tube and a wobble transmission which drives the striking piston in translation and exhibits a driver engaging the driving piston and a wobble plate connected rigidly to the driver, which is in engagement with a wobble element mounted integrally in rotation on the driving shaft, characterised in that the wobble element (429) is arranged on the driving shaft (420) with axial sliding mobility counter to the action of at least one return spring (404,405).

32. Machine according to Claim 31, characterised in that the wobble element (429) and the driving shaft (420) are mutually connected via a pinion tooth system (403), and that a compression spring (404,405), preferably a helicoidal compression spring surrounding the driving shaft (420), is braced on each of the two sides of the wobble element (429) against the latter and against a stop, preferably a driving shaft bearing (435,436), physically fixed relative to the driving shaft (420).

33. Any of the hand machine tools substantially as herein described with reference to the accompanying drawings.

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